ETH
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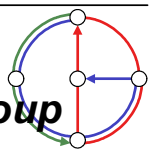
Distributed Computing Group



WS 2006/2007 Dr. C. Stamm / Roland Flury / Stefan Schmid

Discrete Event Systems
Exercise 5

1 Pumping Lemma revisited

a) Determine whether the language $L = \{1^{n^2} | n \geq 1\}$ is regular.

b) Consider a regular language L and a pumping number p such that every word $u \in L$ can be written as $u = xyz$ with $|xy| \leq p$ and $|y| \geq 1$, and that $xy^iz \in L \ \forall i \geq 0$.

What can you say about the minimum number of states needed for the corresponding DFA? What about the minimum number of states of the corresponding the NFA?

2 Push Down Automaton

For each of the following languages, draw a PDA (if possible deterministic) that accepts L.

a) $L = \{a^ib^ja^jb^i \mid i, j > 0\}$

b) $L = \{u \mid u \in \{0|1\}^*, \text{ and } u^{reverse} = u\}$

c) $L = \{u \mid u \in \{0|1\}^*, \text{ and } u^{reverse} \neq u\}$

3 Context Free Grammars

For each of the following languages give a CFG describing L.

a) $L = \{x\#y \mid x, y \in \{a, b\}^*, \text{ and } x \text{ is not a permutation of } y\}$

b) $L = \{x\#y \mid x, y \in \{a, b\}^*, \text{ and } x \neq y\}$

4 Tandem Pumping

For the following languages, determine whether they are context free or not.

a) $L = \{a^ib^jc^k \mid 0 < i < j < k\}$

b) $L = \{x \mid x \in \{0, 1\}^*, \text{ and } x \text{ contains an even number of '0' and an even number of '1'}\}$

c) $L = \{x\#y \mid x, y \in \{0, 1\}^*, \text{ and } x \text{ is a permutation of } y\}$